of securing a university education in England. It is narrated how this difficulty was overcome, so that in 1881, at the age of 23, he was able to enter the University of Cambridge as a scholar of Christ's College, the college of which his brother-in-law, Mr. A. M. Bose, the first Indian wrangler, had become a member ten years previously. It may be incidentally mentioned here that Mr. Fitzpatrick, who is mentioned as one of his college friends (p. 29), is not, as stated, Master of Emmanuel College, but President of Queens' College. Having successfully completed his university career, Bose returned to India to face the next serious difficulty—that of obtaining a suitable educational post. It is explained how impossible it seemed to the official mind that a native of India should be fitted by ability and attainments for a professorship in physical science—there was no precedent for such a claim! However, chiefly by the influence of the then Viceroy, Lord Ripon, Bose was appointed professor of physics in the Presidency College, Calcutta, a post which he held until 1915. During this period he was busily engaged, not only in maintaining and increasing the efficiency of his department by securing adequate laboratory accommodation, but also in carrying on the researches that have made his name famous.

Of these researches the author gives an attractively lucid and succinct account. The first were wholly physical, and to these three chapters (iv.–vi.) are devoted. Their main subject was that of the properties of the Hertzian electric waves, by which wireless telegraphy is effected. It is of interest to note that, so far back as 1895, Bose had demonstrated the passage of these waves from one part to another of his laboratory building. In the course of this work he observed that his metallic receivers manifested signs of "fatigue," an observation which led him to a comparison, in this respect, of metals and of animal- and plant-tissues, with the result that he found them to be essentially identical (chap. vii., "Response in Living and Non-Living"). He became so deeply interested in the study of the irritability and movements of plants that for the next twenty years he devoted himself almost exclusively to it. An adequate account of his remarkable work in this direction is given in chaps. ix.-xv. The results may be summed up in the brief statement that the phenomena of irritability of animals and plants are altogether analogous, and that the multiform movements of plants are susceptible of a simple universal explanation, depending fundamentally on the quantity of stimulus received. These great generalisations were rendered possible by the employment of recording apparatus much more delicate than any previously devised, and capable of magnifying the minute movements a thousand or even a million times. The last, and the most formidable, of the difficulties to be overcome was that of securing recognition of his work. So long as Bose's researches were confined to purely physical subjects it did not arise; but when he trespassed into the domain of physiology opposition became strong in this country, though on the Continent and in America his results were received with enthusiasm. Here the antiquated idea of "water-tight compartments" in science asserted itself to such an extent that it was not for many years that justice was done. All this is fully discussed in the author's pages, where it is also made clear that ultimate triumph was due not to ability alone, but mainly to strength of character and lofty ideals.

The sub-title of the book is "An Indian Pioneer of Science." Like all pioneers, Sir J. C. Bose has had to encounter many and great difficulties and, as has been pointed out, he has, unlike many pioneers, successfully overcome them. It is to be hoped that, now that the days of storm and stress are over, he may be able to devote all his energy to the continuance of his work in the Institute that he has founded for the purpose. The volume is well got up, and is illustrated with portraits and many figures of apparatus and records. It would have been an advantage if a full bibliography of Sir J. C. Bose's works had been appended, while the index would be more useful if it were more complete.

Elementary Geometry.

Practical Geometry. By C. Godfrey and A. W. Siddons. Pp. xv+256. *Theoretical Geometry: A Sequel to "Practical Geometry."* By C. Godfrey and A. W. Siddons. Pp. xiv+104. (Cambridge: At the University Press, 1920.) Price 7s. net. (Complete in one volume.)

THE authors of these two volumes (obtainable also as a single book) regard the teaching of geometry as divisible into four stages. The first consists of little more than instruction in the use of instruments and methods of measurement, including drawing to scale. The second is an intuitive treatment of a few fundamental propositions, and merges into the third stage, which covers the whole field of the ordinary course of elementary geometry, plane and solid, treating the various theorems in an informal fashion, and explaining the methods of constructions, often without proof, in the natural order suggested by the theorems. In these stages the pupil is led to apply the results of the theorems, whether formally proved or not, both to numerical

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examples and to formal riders. The fourth stage knits all the theorems, previously considered, into a logical chain with formal proof. A few riders are interspersed, and there is a considerable amount of general discussion in this part of the text; the section closes with a collection of riders arranged under headings corresponding to suitable groups of propositions.

With the general changes of procedure adopted by the authors we are in entire agreement. There can be no question that boys are capable of making simple applications of the fundamental theorems of geometry long before they are able to appreciate the formal proofs, and the stimulus which work of this nature supplies is most beneficial to their mental development.

On its numerical side the exercises are very good, being numerous, varied, and interesting; on the formal side we do not consider the work quite so satisfactory; more riders of the "two-step" nature are needed, particularly, for example, in dealing with angle and tangent properties of the circle. We think also that much of the discussion, which at present bulks so largely in the text, might be omitted. We doubt whether any boy reads it, and there is much that we find hard to believe is really necessary for the instruction of the teacher at the present time, when modern methods are so much better understood than they were, say, fifteen years ago. Some drastic pruning of this kind would affect materially the size of the book, and, we think, leave its utility unimpaired, and at the same time appear to lighten the student's burden.

The printing is excellent, and the diagrams are clear and numerous. A set of answers and suggestions for class-work (which we have not seen) is issued separately. We regard the new form of this text-book as a definite advance in the right direction, and commend it to teachers.

The Evolution of Vertebrate Animals.

Die Stämme der Wirbeltiere. By Prof. Othenio Abel. Pp. xviii+914. (Berlin and Leipzig: Walter de Gruyter and Co., 1919.) Price 56 marks.

PROF. ABEL, of Vienna, is a most voluminous writer on extinct animals, and even the difficult circumstances of the time do not impair his energy and enthusiasm. He has now produced a most interesting volume summarising our present knowledge of the past history of the backboned animals, and his technical descriptions are illustrated by numerous up-to-date figures which are refreshing by their newness in a text-book. The work is not merely a laborious compendium, but is enlivened by many critical observations based on Prof. Abel's own researches.

Prof. Abel's classification will not in all respects prove acceptable. He avoids too many difficulties in the determination of affinities by an undue multiplication of sub-classes and orders. He also in some cases adopts the fantastic proposals of certain dabblers in scientific literature who discuss merely names without any acquaintance with the fossils to which they refer. The familiar generic name Ichthyosaurus, for example, completely disappears, while the almost equally well-known name Megalichthys is applied to the wrong fish. The work, however, is intended for advanced students who will be able to make allowance for these idiosyncrasies without much trouble.

According to Prof. Abel, the Cyclostomes are unknown among fossils, because the problematical Devonian Palæospondylus, with its suctorial mouth, is most likely the larval condition of Coccosteus. The earliest fishes are the Upper Silurian Anaspida. The earliest land-vertebrates, the Stegocephala, are treated at great length on account of the primitive character of the skeleton and its morphological importance. Among reptiles, the newly discovered Chelonia, from the Upper Trias of Germany, are especially striking. Some of them retain traces of true teeth. The Dicynodonts are described as "the Sirenians among reptiles." The Triassic Parasuchia and Pseudosuchia are separated from the Crocodilia. The marine Thalattosauria, from the Trias of California, are arranged with the Lacertilia. The birds are treated in the usual manner.

Among mammals, the Monotremata are regarded as unknown by fossils before the Pleistocene; and the Triassic Tritylodon is referred to the Marsupialia. The South American Tertiary Sparassodonta are also retained among Marsupialia. A few of the mammalian jaws of Jurassic age (*e.g.* Amphitherium and Stylodon) are regarded as belonging to Placentalia. The Insectivora follow, and the Primates, as usual, conclude the series of orders. The various groups are rather unequally treated, but students will be glad to have the preponderating sections on Cetacea and Sirenia as summarising Prof. Abel's own researches.

The volume is provided with two exhaustive indexes, one to morphology, the other to taxonomy, and is a most valuable work of reference, which should be added to every zoological library.

A. S. W.

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